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(54) Title: GLASS COMPOSITIONS AND FIBERS THEREFROM

(57) Abstract

Fiberizable glass composition with increased levels of BaO are suitable for insulation. These glasses have physical properties which allow current processes to fabricate them into insulation. The glasses also meet proposed German regulations regarding KI ≥ 40.

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GLASS COMPOSITIONS AND FIBERS THEREFROM

TECHNICAL FIELD

This invention relates to sodium barium borosilicate glass compositions. Fibers from these compositions make glass fiber insulation.

BACKGROUND ART

Glass fiber insulation is well known and has been a commercial product for a long period of time. The insulation is made from intertwined soda lime alumina borosilicate glass fiber which a binder holds together. The binder may be any suitable material but quite commonly is a phenol-formaldehyde resin or a ureaformaldehyde resin. These binders are well known, and a spray nozzle generally applies them to the glass fibers as hot gases attenuate the fibers from a rotating device, commonly called a spinner. A conveyer collects the binder-coated fibers in the form of a blanket, and heat cures the blanket to produce the final insulation. The process produces various densities by varying the conveyor speed and the thickness of the cured insulation.

The German government has proposed regulations for glass fibers. Glass fiber compositions meeting the regulations are considered to be free of suspicion. The problem, however, for the manufacturer is to produce glass fibers which meet the regulations and standard criteria. These glasses must meet the proposed regulations, be fiberizable in standard wool processes, have sufficient durability, and have acceptable insulating properties.

DISCLOSURE OF INVENTION

We have developed glass compositions which meet all the criteria. Our glasses have a high BaO content, a high soda content, and contain small amounts of alumina. The glass compositions meet the proposed German regulations. They have a numerical index (KI) greater than or equal to 40. Standard wool processes easily produce fibers from these compositions. The difference (delta T) between the temperature where the glass has a viscosity of 1,000 poise and the liquidus temperature generally is 50°F (28°C) and is often 200°F (111°C) or greater. Durability as shown by fiber weight loss is good and is often less than 5% fiber weight loss after 24 hours in water at 205°F (96°C).

BEST MODE FOR CARRYING OUT THE INVENTION

We made measurements of viscosity, liquidus, and durability for a number of glasses with KI ≥ 40. The measurements indicated a compositional region of glasses which are useful for production of glass fiber insulation. This range is as follows for the major components:

Ingredients	Weight Percent
SiO_2	45-60
Al_2O_3	0-3
B_2O_3	0-20
$Na_2O + K_2O$	12-22
$MgO + CaO$	0-14
BaO	2-35

and less than about 10% of any or all of ZnO, TiO_2, Fe_2O_3, ZrO_2, SrO, or Li_2O, the total being 100% by weight, wherein each glass composition has a KI value equal to or greater than 40.

More preferably, the glass compositions consist essentially of:

Ingredients	Weight Percent
SiO_2	45-57
Al_2O_3	0.8-3
B_2O_3	0-18
$Na_2O + K_2O$	12-22
$MgO + CaO$	0-14
BaO	2-30

and less than about 5% of any or all of ZnO, TiO_2, Fe_2O_3, ZrO_2, SrO, or Li_2O, the total being 100% by weight, and wherein each glass composition has a KI value equal to or greater than 40.

Even more preferably, the glass compositions have a BaO content of 5 to 30 weight percent and less than about 2% of any or all of ZnO, TiO_2, Fe_2O_3, ZrO_2, SrO, or Li_2O. Even more preferably the glass compositions have a BaO combat of 12 to 25 weight percent, and less than 2% of any or all of ZnO, TiO_2, Fe_2O_3, ZrO_2, SrO, or Li_2O.

Insulation products of these glass fibers can be produced from a conventional fiber-forming process.

The German regulation requires a numerical index (KI) greater than or equal to 40 to be considered free of suspicion. The index is calculated by KI = Σ (Na_2O, K_2O, CaO, MgO, BaO, B_2O_3) - $2Al_2O_3$. This places severe restrictions on alumina levels and anything not included in the index, such as silica. The obvious choice is to lower alumina to very low levels. These glasses, however, have poor durabilities and most could not be fiberized by a standard wool process. We discovered that high BaO levels yielded glasses with significantly improved durability and fiberizability by standard processes.

We designed an array of glasses to show the effect of glass composition in this narrow field on select properties. All glasses are shown together with measured properties in the following table.

Examples of the compositions are given in the following table. All the glass compositions have KI index of 40 or higher.

<u>Example 1</u>

Glass fibers of the present invention have the following compositions. Most of the compositions have measured forming temperatures (the temperature where the viscosity of the glass is about 1,000 poise) and liquidus temperatures.

TABLE

Weight Percent

Ingredients	1	2	3	4	5	6	7	8
SiO_2	54.5	55.0	56.3	56.4	56.5	56.5	56.3	56.4
Al_2O_3	0.9	1.0	1.0	1.0	1.0	0.9	1.0	1.0
B_2O_3	1.5	1.5	15.1	13.3	9.8	6.2	13.3	11.6
Na_2O	12.4	12.5	14.5	14.4	14.1	13.8	14.6	14.5
K_2O	6.0	6.0	0.8	0.8	0.7	0.7	0.8	0.8
MgO	1.1	1.1	2.6	2.6	2.5	2.5	3.1	3.0
CaO	3.1	3.1	7.3	7.1	7.0	6.9	8.5	8.4
BaO	17.8	17.8	2.0	4.0	8.0	12.1	2.0	4.0
TiO_2	-	-	0.1	0.1	0.1	0.1	0.1	0.1
Fe_2O_3	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3
ZrO_2	2.5	1.8	-	-	-	-	-	-
Temperature °F (°C) for Viscosity of 1,000 Poise	1903 (1039)	1882 (1028)	1737 (947)	1738 (948)	1761 (961)	1789 (976)	1739 (948)	1747 (953)
Liquidus Temperature °F (°C)	1524 (829)	- (-)	1498 (814)	1481 (805)	1548 (842)	1553 (845)	1578 (859)	1567 (853)
KI	40.0	40.0	40.3	40.3	40.3	40.3	40.3	40.3
Durability (% Wt Loss of Fibers After 24 Hours)*	7.0	-	4.7	4.3	3.8	3.6	-	-

*Exposure to water at 205°F (96°C)

Ingredients	9	10	11	12
SiO_2	54.5	54.4	55.2	54.8
Al_2O_3	1.0	1.0	1.6	1.7
B_2O_3	15.2	15.4	-	-
Na_2O	14.5	14.4	15.5	16.5
K_2O	0.8	0.8	-	-
MgO	2.6	2.6	-	1.8
CaO	7.2	7.2	-	4.0
BaO	2.0	2.0	27.7	21.2
TiO_2	2.0	0.1	-	-
Fe_2O_3	0.3	0.3	-	-
ZrO_2	-	2.0	-	-
Temperature °F (°C) for Viscosity of 1,000 Poise	1714 (934)	1740 (949)	1882 (1028)	1867 (1019)
Liquidus Temperature °F (°C)	1538 (837)	1551 (844)	- (-)	- (-)
KI	40.3	40.3	40.0	40.0
Durability (% Wt Loss of Fibers After 24 Hours)*	-	-	-	-

*Exposure to water at 205°F (96°C)

CLAIMS

1. Fiberizable glass compositions suitable for insulation consisting essentially of:

Ingredients	Weight Percent
SiO_2	45-60
Al_2O_3	0-3
B_2O_3	0-20
$Na_2O + K_2O$	12-22
$MgO + CaO$	0-14
BaO	2-35

and less than about 10% of any or all of ZnO, TiO_2, Fe_2O_3, ZrO_2, SrO, or Li_2O, the total being 100% by weight, and wherein each glass composition as a KI value equal to or greater than 40.

2. Fiberizable glass compositions suitable for insulation consisting essentially of:

Ingredients	Weight Percent
SiO_2	47-57
Al_2O_3	0.8-3
B_2O_3	0-18
$Na_2O + K_2O$	12-22
$MgO + CaO$	0-14
BaO	2-30

and less than about 5% of any or all of ZnO, TiO_2, Fe_2O_3, ZrO_2, SrO, or Li_2O, the total being 100% by weight, and wherein each glass composition as a KI value equal to or greater than 40.

3. Glass compositions according to claim 2 having a BaO content of 5 to 30 weight percent and less than about 2% of any or all of ZnO, TiO_2, Fe_2O_3, ZrO_2, SrO, or Li_2O.

4. Glass compositions according to claim 2 having a BaO content of 12 to 25 weight percent and less than about 2% of any or all of ZnO, TiO_2, Fe_2O_3, ZrO_2, SrO, or Li_2O.

5. Glass compositions according to claim 1 having the compositions of:

Ingredients	Weight Percent
SiO_2	54.5
Al_2O_3	0.9
B_2O_3	1.5
Na_2O	12.4
K_2O	6.0
MgO	1.1
CaO	3.1
BaO	17.8
Fe_2O_3	0.2
ZrO_2	2.5

6. Glass fibers having glass compositions according to any one of claims 1 to 5.

7. Glass fiber insulation comprising a collection of glass fibers according to claim 6.

INTERNATIONAL SEARCH REPORT

Intx ...onal Application No
PCT/US 96/05992

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C03C13/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C03C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Reedijk, A

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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